

IN THE CLAIMS

For the convenience of the Examiner, all pending claims of the Application are reproduced below regardless of whether amended or not.

~~[[1]]~~ 1. ~~(Amended)~~ An Autoprotected ~~autoprotected~~ optical communication ring network, including comprising:

a first and a second optical carrier ~~[[2, 3]]~~ having opposite transmission directions; and

a plurality of optically reconfigurable nodes ~~(20a-20f)~~ optically connected along the first and ~~[[the]]~~ second optical ~~carrier~~ carriers ~~[[2, 3]]~~ and adapted to communicate in pairs by ~~means of~~ respective links susceptible ~~[[of]]~~ to failure, the ring network having a nominal operative condition in which the nodes of each ~~[[pair]]~~ of the pairs are optically configured so as to exchange optical signals on a respective working arc path at a respective first wavelength (λ_x) on the first carrier ~~[[2]]~~ and at a respective second wavelength (λ_y) different from said first wavelength (λ_x) on the second carrier ~~[[3]]~~, said respective working path having a complementary arc path defining a respective protection arc path in which the first wavelength (λ_x) on the first carrier ~~[[2]]~~ and the second wavelength (λ_y) on the second carrier ~~[[3]]~~ can be used for further links and the first wavelength (λ_x) on the second carrier ~~[[3]]~~ and the second wavelength (λ_y) on the first carrier ~~[[2]]~~ are reserved for protection, characterized in such that the ring network has a failure operative condition in which the nodes terminating a ~~failed~~ failed link are optically reconfigured so as to exchange optical signals on the respective protection arc path at the respective second wavelength (λ_y) on the first carrier ~~[[2]]~~ and at the respective first wavelength (λ_x) on the second carrier ~~[[3]]~~, wherein the reconfiguration of one or more of the nodes reflects reconfiguration at a channel level associated with the ring network.

~~[[2]] 2. (Amended) The [[Ring]] ring network according to claim of Claim 1, wherein each of said plurality of reconfigurable nodes (20a-20f) is adapted configured to manage a predetermined subset of wavelengths within a set of transmission wavelengths, $(\lambda_1, \lambda_2, \dots, \lambda_N)$ and wherein each of the nodes includes a first and a second optical add/drop multiplexer ~~[[4, 5]]~~ that may be serially connected to said first and, respectively, second carrier carriers ~~[[2, 3]]~~ respectively in order to feed/extract communicate said subset of wavelengths to ~~[[/from]]~~ said first and, respectively, second carrier carriers (2, 3), and to pass through the remaining wavelengths of the set of transmission wavelengths $(\lambda_1, \lambda_2, \dots, \lambda_N)$.~~

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~~[[3]] 3. (Amended) The [[Ring]] ring network according to claim of Claim 1 [[or 2]], wherein said plurality of reconfigurable nodes (20a-20f) includes at least a signal input, (IN_1, IN_2) , at least a signal output, (OUT_1, OUT_2) and a reconfigurable optical switch unit $(15; 15'; 15''; 115'; 115''; 215)$ selectively coupling operable to couple said at least a signal input (IN_1, IN_2) and said at least a signal output (OUT_1, OUT_2) to said first and second carriers ~~[[2, 3]]~~ respectively.~~

~~[[4]] 4. (Amended) The [[Ring]] ring network according to claim of Claim 3, wherein said at least a signal input (IN_1, IN_2) is optically coupled to a respective an optical transmitter ~~[[TX₁]]~~ and said at least a signal output (OUT_1, OUT_2) is optically coupled to a respective an optical receiver ~~[[RX₁]]~~.~~

~~[[5]] 5. (Amended) The [[Ring]] ring network according to claim of Claim 3 [[or 4]], wherein each of said plurality of reconfigurable nodes (20a-20f) includes information insertion devices $(TxTs)$ selectively optically connectable coupled to said at least a signal input (IN_1, IN_2) and adapted to ~~[[insert]]~~ position signalling signaling information into one or more ~~[[the]]~~ optical signals and information extraction devices $(RxTs)$ selectively optically connectable to said at least a signal output (OUT_1, OUT_2) and adapted to extract signalling information from the optical signals.~~

~~[[6]] 6. (Amended) The [[Ring]] ring network according to claim of Claim 5, wherein said information insertion devices (TxTs) and said information extraction devices (RxTs) include optical transponders operable to optically coupling couple said optical switch unit (15; 15'; 15"; 115'; 115"; 215) to said first and second carrier carriers(2, 3) and adapted to change the signals wavelengths.~~

7) 7. (Amended) The [[Ring]] ring network according to claim of Claim 3, wherein at least one of said reconfigurable nodes (20a-20f) includes at least a first signal splitter splitter (222-225) adapted to receive a signal from either a selected one of the first [[or]] and the second carrier carriers [(2, 3)] and to split said signal into a first and a second fraction which are sent towards to be communicated toward a respective signal output (OUT₁, OUT₂) and towards the same carrier (2, 3), respectively.

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~~[[8]] 8. (Amended) The [[Ring]] ring network according to claim of Claim [[3]] 7, wherein at least a selected one or more of said reconfigurable nodes includes at least a second signal splitter splitter (221, 226) optically coupled to a respective signal input (IN₁, IN₂) and adapted to [[split]] split a signal coming from the respective signal input (IN₁, IN₂) into a first and a second fraction which are sent towards to be communicated toward the first carrier (2) and [[the]] second carrier carriers [(3)], respectively.~~

9) 9. (Amended) The [[Ring]] ring network according to claim of Claim 3, wherein said optical switch unit [[(215)]] includes at least a first switch (231, 233, 235, 236) having a first input that is optically coupled to a respective signal input (IN₁, IN₂), a second input coupled to either the first or the second carrier (2, 3) and an output coupled to the same carrier (2, 3).

10) 10. (Amended) The [[Ring]] ring network according to claim of Claim [[8]] 9, wherein said optical switch unit [[(215)]] includes at least a second switch (232, 234) having a first input that is coupled to the first carrier [(2,)] and a second input that is coupled the second carrier [(3)], and wherein an output of the second switch is optically coupled to a respective signal output (OUT₁, OUT₂).

11) ~~(Canceled)~~ Optical transmission system, including a first and a second ring network according to claim 3, wherein a first reconfigurable node (D) of the first ring network has a signal input (IN₁, IN₂) which is optically coupled to a signal output (OUT₁, OUT₂) of a second reconfigurable node (D') of the second ring network.

12) ~~(Canceled)~~ Optical transmission system according to claim 11, wherein the second reconfigurable node (D') has a signal input (IN₁, IN₂) which is optically coupled to a signal output (OUT₁, OUT₂) of the first reconfigurable node (D).

13) ~~(Canceled)~~ Optical transmission system according to claim 11, wherein a third reconfigurable node (E) of the first ring network has a signal input (IN₁, IN₂) which is optically coupled to a signal output (OUT₁, OUT₂) of a fourth reconfigurable node (E') of the second ring network, and the fourth reconfigurable node (E') has a signal input (IN₁, IN₂) which is optically coupled to a signal output (OUT₁, OUT₂) of the third reconfigurable node (E).

14) 14. (Amended) ~~A method~~ Method to autoprotect an optical ring network, said ring network including a first and a second optical carrier having opposite transmission directions and a plurality of nodes optically connected along the first and the second optical ~~carrier~~ carriers and adapted to communicate in pairs in order to define bidirectional links, each ~~[[pair]]~~ of the pairs including a first and a second link termination node adapted to mutually communicate at respective first and second wavelengths, the method ~~including~~ comprising:

exchanging signals between the first and the second link termination ~~[[node]]~~ nodes of each pair on a respective working arc path of said ring network by using the respective first wavelength on the first carrier and the respective second wavelength on the second carrier~~[[;]]~~, said ~~respective~~ working path having a complementary arc path defining a respective protection arc path in which the first wavelength on the first carrier and the second wavelength on the second carrier can be used for further links, wherein ~~[[and]]~~ the first wavelength on the second carrier and the second wavelength on the first carrier are reserved for protection;

checking if a failure is present in the ring network producing ~~at least a failed~~ failed link; and

optically reconfiguring, in the presence of ~~[[a]]~~ the failure, the link terminating nodes of said ~~at least a failed~~ failed link so that they ~~exchange~~ signals may be exchanged on the respective protection arc path by using the respective first wavelength on the second carrier and the respective first wavelength on the second carrier, wherein the reconfiguration of one or more of the nodes reflects reconfiguration at a channel level associated with the ring network.

15) 15. (Amended) The method ~~Method according to claim~~ of Claim 14, wherein each node of said plurality of nodes is adapted to manage a predetermined subset of wavelengths within a set of transmission wavelengths carried by the first and the second ~~carrier~~ carriers, said step of exchanging including ~~optically separating, at each node of said plurality of nodes, each wavelength of the respective subset of wavelengths from~~ ~~[[the]]~~ a set of transmission wavelengths.

~~[[16]]~~ **16.** (Amended) The method ~~Method according to claim of Claim 14, including the~~
steps of further comprising:

inserting a signal into one of said nodes~~[[,]]~~;
splitting said signal into a first and a second fraction; and
sending said first fraction ~~towards~~ toward the first carrier and the second ~~[[power]]~~
fraction ~~towards~~ toward the second carrier.

~~[[17]]~~ **17.** (Amended) The method ~~Method according to claim of Claim 14, including the~~
steps of further comprising:

receiving a signal in one of said nodes from either the first or the second carrier~~[[,]]~~;
splitting said signal into a first and a second fraction; and
sending the first fraction ~~towards~~ toward the same carrier and the second fraction
~~towards a signal output of said node.~~

18) (Canceled) Method according to claim 14, wherein the step of checking includes
verifying, in each node of said plurality of nodes and for each wavelength of the respective set of
wavelengths, if signals are received.

19) (Canceled) Method according to claim 14, wherein said step of checking includes
verifying, in each node of said plurality of nodes and for each wavelength of the respective set of
wavelengths, if signals are received degraded.

20) (Canceled) Method according to claim 14, wherein said step of checking includes
verifying, in each node of said plurality of nodes and for each wavelength of the respective set of
wavelengths, if signals include a failure message.

~~21)~~ **21.** (Amended) The method ~~Method according to claim of Claim 14, further~~
including comprising:

transmitting a failure message from ~~[[a]]~~ the first link termination node ~~of a pair~~ to ~~[[a]]~~
the second link termination node ~~of the same pair~~ if a signal transmitted from the second link
termination node to the first link termination node is not received~~[[,]]~~ or is ~~received~~ degraded, ~~by~~
~~the first link termination node.~~

~~[[22]] 22. (Amended) The method Method according to claim of Claim 14, wherein said step of optically reconfiguring includes switching optical connections ~~[[which]]~~ that selectively couple at least an optical transmitter and an optical receiver to said first and second carrier carriers respectively.~~

~~[[23]] 23. (Amended) The method Method according to claim 15 of Claim 14, wherein the step of exchanging signals includes feeding at each of said plurality of nodes the corresponding subset of wavelengths to said first and, respectively, second carrier. following steps executed in the first link termination node:~~

~~generating an optical signal carrying information;~~

~~converting the optical signal into an electrical signal;~~

~~adding information to the electrical signal;~~

~~reconverting the electrical signal into an optical signal provided with a~~

~~predetermined wavelength adapted for transmission; and~~

~~communicating the optical signal at the predetermined wavelength to a selected one of the first and the second carriers.~~

~~[[24]] 24. (Amended) The method Method according to claim of Claim 14, wherein the step of exchanging signals includes the following steps executed in the ~~[[first]]~~ second link termination node of a pair:~~

~~— generating an optical signal carrying an information;
— converting the optical signal in a electrical signal;
— adding to the electrical signal further information;
— reconverting the electrical signal in an optical signal provided with a predetermined wavelength adapted for transmission; and
— feeding the optical signal at the predetermined wavelength to either the first or the second carrier;
— and the following steps executed in the second link termination node of the same pair:
receiving the optical signal at the predetermined wavelength from either a selected one of the first ~~[[or]]~~ and the second carrier carriers;
converting the optical signal at the predetermined wavelength ~~[[in]]~~ into an electrical signal;
extracting information from the electrical signal ~~the further information~~;
reconverting the electrical signal ~~[[in]]~~ into an optical signal with a wavelength adapted for reception; and
receiving the optical signal with the wavelength adapted for reception.~~

25) **(Canceled)** Reconfigurable node for an autoprotected optical communication ring network, comprising a receiving/transmitting module (6) including:

- a signal input (IN_1) for the insertion into the node of a signal including information to be transmitted in the network;
- a signal output (OUT_1) for the extraction from the node of a signal including information transmitted in the network;
- a first transmitting transponder ($TxT_1(\lambda_x)$) for optically coupling to a first carrier (2) of the network and adapted to modulate a signal at a first wavelength (λ_x);
- a second transmitting transponder ($TxT_1(\lambda_y)$) for optically coupling to the first carrier (2) and adapted to modulate a signal at a second wavelength (λ_y);
- a third transmitting transponder ($TxT_2(\lambda_x)$) for optically coupling to a second carrier (3) of the network and adapted to modulate a signal at the first wavelength (λ_x);
- a first receiving transponder ($RxT_2(\lambda_x)$) for optically coupling to the second carrier (3) and adapted to demodulate a signal having the first wavelength (λ_x);
- a second receiving transponder ($RxT_2(\lambda_y)$) for optically coupling to the first carrier (2) and adapted to demodulate a signal having the second wavelength (λ_y);
- a third receiving transponder ($RxT_1(\lambda_y)$) for optically coupling to the second carrier (3) and adapted to demodulate a signal having the second wavelength (λ_y);
- reconfigurable optical connections (22-25; 31-38; 41-48; 131-136; 141-146; 231-236) to selectively connect:
 - the signal input (IN_1) either to the first transmitting transponder ($TxT_1(\lambda_x)$) to the third transmitting transponder ($TxT_2(\lambda_x)$);
 - the first receiving transponder ($RxT_2(\lambda_x)$) the third transmitting transponder ($TxT_2(\lambda_x)$);
 - the second receiving transponder ($RxT_2(\lambda_y)$) the signal output (OUT_1); and
 - the third receiving transponder ($RxT_1(\lambda_y)$) either to the signal output (OUT_1) or to the second transmitting transponder ($TxT_1(\lambda_y)$)

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26) **(Canceled)** Reconfigurable node according to claim 25, wherein the receiving/transmitting module (6) further includes:

- a further signal input (IN_2) for the insertion into the node of a signal including information to be transmitted in the network;
- a further signal output (OUT_2) for the extraction from the node of a signal including information transmitted in the network;
- a fourth transmitting transponder ($TxT_2(\lambda_y)$) optically coupled to the second carrier (3) and adapted to modulate a signal at the second wavelength (λ_y); and
- a fourth receiving transponder ($RxT_1(\lambda_x)$) optically coupled to the first carrier (2) and adapted to demodulate a signal having the first wavelength (λ_x);

said reconfigurable optical connections (22-25; 31-38; 41-48; 131-136; 141-146; 231-236) selectively connecting:

- the first receiving transponder ($RxT_2(\lambda_x)$) either to the third transmitting transponder ($TxT_2(\lambda_x)$) or to the further signal output (OUT_2);
- the fourth receiving transponder ($RxT_1(\lambda_x)$) to the further signal output (OUT_2); and
- the further signal input (IN_2) either to the second transmitting transponder ($TxT_1(\lambda_y)$) to the fourth transmitting transponder ($TxT_2(\lambda_x)$).

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27) **(Canceled)** Reconfigurable node according to claim 25 or 26, characterized in that it is adapted to manage a predetermined set of wavelengths within a set of transmission wavelengths ($\lambda_1, \lambda_2, \dots, \lambda_N$) and in that it includes a first and a second optical add/drop multiplexer (4, 5) optically coupling the receiving/transmitting module (6) to said first and, respectively, second carrier (2, 3) to feed/extract said subset of wavelengths to/from said first and, respectively, second carrier (2, 3), and to pass-through the remaining wavelengths of the set of transmission wavelengths ($\lambda_1, \lambda_2, \dots, \lambda_N$).

28) **(Canceled)** Reconfigurable node according to claim 25 or 26, further including at least a first optical power splitter (221) for splitting signals coming from said at least a signal input (IN_1) and at least a second optical power splitter (222-225) for splitting signals coming from a respective one of said receiving transponders ($RxTs$).

29) **(Canceled)** Reconfigurable node according to claim 25 or 26, wherein the reconfigurable optical connections (22-25) include 2x2 switches.

30) **(Canceled)** Reconfigurable node according to claim 25 or 26, wherein the reconfigurable optical connections (31-38; 41-48; 131-136; 141-146; 231-236) include 1x2 and/or 2x1 switches.

31) **(Canceled)** Reconfigurable node according to claim 25 or 26, wherein the reconfigurable optical connections (22-25; 31-38; 41-48; 131-136; 141-146; 231-236) include discrete switching components.

32) **(Canceled)** Reconfigurable node according to claim 25 or 26, wherein the reconfigurable optical connections (22-25; 31-38; 41-48; 131-136; 141-146; 231-236) include an integrated switching matrix.

33) **(Canceled)** Reconfigurable node according to claim 25 or 26, wherein the reconfigurable optical connections (22-25; 31-38; 41-48; 131-136; 141-146; 231-236) include optical switching components selectable in the group including:

- opto-mechanical switches;
- thermo-optical switches;
- magneto-optical switches;
- liquid crystal switches;
- semiconductor switches;
- electro-optical switches;
- micro-mechanical switches; and
- lithium niobate integrated circuit switches.

34) **(Canceled)** Reconfigurable node according to claim 25 or 26, characterized in that it includes a control processing unit (16) operatively connected to said receiving transponders (RxTs) and said transmitting transponders (TxTs).

35) **(Canceled)** Reconfigurable node according to claim 25 or 26, characterized in that it includes at least a further receiving/transmitting module which has substantially the same structure of said receiving/transmitting module (6) and is adapted to operate with a different pair of wavelengths with respect to said receiving/transmitting module (6).
